

## PATENT COOPERATION TREATY

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## INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 02804-04 La/ej	<b>FOR FURTHER ACTION</b>		See Form PCT/PEA416
International application No. PCT/CA 03/00616	International filing date (day/month/year) 29.04.2003	Priority date (day/month/year) 29.04.2003	
International Patent Classification (IPC) or national classification and IPC F23C10/10			
Applicant HER MAJESTY IN RIGHT OF CANADA AS REPRESENTED...			
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 5 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> sent to the applicant and to the International Bureau a total of 4 sheets, as follows:</p> <p><input checked="" type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>			
<p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the opinion</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input type="checkbox"/> Box No. VIII Certain observations on the international application</p>			
Date of submission of the demand  26.11.2004		Date of completion of this report  17.08.2005	
Name and mailing address of the international preliminary examining authority:  European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016		Authorized Officer  Gruber, M  Telephone No. +31 70 340-9824	



**INTERNATIONAL PRELIMINARY REPORT  
ON PATENTABILITY**

International application No.  
PCT/CA 03/00616

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**Box No. I Basis of the report**

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1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
  - ☐ publication of the international application (under Rule 12.4)
  - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements\*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

**Description, Pages**

1, 2, 4, 6-11	as originally filed
3, 5	received on 26.11.2004 with letter of 26.11.2004

**Claims, Numbers**

1(part), 2-15	as originally filed
1(part), 16, 17	received on 26.11.2004 with letter of 26.11.2004

**Drawings, Sheets**

1/1	as originally filed
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- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3. ☐ The amendments have resulted in the cancellation of:
- ☐ the description, pages
  - ☐ the claims, Nos.
  - ☐ the drawings, sheets/figs
  - ☐ the sequence listing *(specify)*:
  - ☐ any table(s) related to sequence listing *(specify)*:
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
- ☐ the description, pages
  - ☐ the claims, Nos.
  - ☐ the drawings, sheets/figs
  - ☐ the sequence listing *(specify)*:
  - ☐ any table(s) related to sequence listing *(specify)*:

\* If item 4 applies, some or all of these sheets may be marked "superseded."

**INTERNATIONAL PRELIMINARY REPORT  
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International application No.  
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**Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

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**1. Statement**

Novelty (N)	Yes: Claims	1-17
	No: Claims	
Inventive step (IS)	Yes: Claims	
	No: Claims	1-17
Industrial applicability (IA)	Yes: Claims	1-17
	No: Claims	

**2. Citations and explanations (Rule 70.7):**

**see separate sheet**

**Re Item V**

**Reasoned statement with regard to novelty, inventive step or industrial applicability;  
citations and explanations supporting such statement**

Reference is made to the following documents:

- D1: US-A-5 662 051 (MORIN JEAN-XAVIER) 2 September 1997 (1997-09-02)
- D2: WO 94/21965 A (COMMUNITY ENERGY ALTERNATIVES ;BAUER ARTHUR M (US); WEISS ALFRED J) 29 September 1994 (1994-09-29)
- D3: US-A-3 807 090 (MOSS G) 30 April 1974 (1974-04-30)

- 1 The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claims 1 to 17 does not involve an inventive step in the sense of Article 33(3) PCT.
- 1.1 The document D1 is regarded as being the closest prior art to the subject-matter of claims 1 and 17, and discloses a method and an apparatus for capturing and recovering carbon dioxide and sulfur dioxide from the combustion of sulfur containing petroleum coke comprising feeding a (major) part of the fuel via line (3,4) to a fluidized bed combustor (boiler 5) that can be run under pressure, combusting the fuel in the presence of air and calcium oxide (recycled or heat transformed limestone), recovering a flue gas containing solids including calcium carbonate and calcium sulphate; separating the solids from the flue gas flow via a dust filter (9), transferring a second portion of fuel via line (15) to a calciner (14), combusting the minor portion of the fuel in the calciner in the presence of air (16), optionally enriched with oxygen (ref. col. 4, lines 23,24), and the separated solids to convert the solids into calcium oxide, carbon dioxide and sulfur dioxide, recovering the solid calcium oxide (24) obtained in the calciner to provide the calcium oxide required in the boiler (5) and returning it to the boiler.

The subject-matter of claims 1 and 17 differs from this known method/apparatus in that solid calcium sulphate obtained in the fluidized bed combustor is not

converted to calcium oxide and sulfur dioxide but just taken out of the process.

It is, however, not clear under which conditions the transformation of calcium sulphate to calcium oxide and sulfur dioxide is prevented (the description only says that "... the temperature in the calciner should not be high enough to degrade calcium sulphate to calcium oxide plus sulfur dioxide ...", it does not say in which temperature range this happens). Furthermore, it is not clear which advantage can be obtained by accumulating solid calcium sulphate instead of regenerating and reusing it in the process.

Another difference is that, according to claims 1 and 17, the fuel is initially split into two fractions. In the prior art, however, a measure with the same effect is provided, i.e. the total amount of fuel is divided and introduced separately into the boiler (5) and the calciner (14). Although the step of dividing is not explicitly displayed in the prior art, no difference in terms of technical effects can be discovered with the "splitting step" in claim 1 of the present application.

- 1.2 Documents D2 and D3 disclose methods and apparatus that are similar to the disclosure of D1, except that air is used in the calciner instead of pure or enriched oxygen.
- 1.3 It is, at present, not clear to which extent the subject matter of claims 2 to 16 causes unexpected or surprising effects with respect to what is disclosed in the above mentioned prior art. Therefore, no inventive activity can be acknowledged for the time being.

Claims.

1. A process for capturing and recovering carbon dioxide  
5 and sulphur dioxide from the combustion of a carbonaceous fuel  
having a high carbon content, a relatively high sulphur  
content and a low ash content, which process comprises:
  - (a) splitting a flow of carbonaceous fuel having a  
particle size compatible with combustion in a fluidised  
10 bed into a major proportion and a minor proportion;
  - (b) transferring the major proportion of the fuel to a  
pressurised fluidised bed combustor and carbonator  
(PFBC/C);
  - (c) combusting the major proportion of the fuel flow in  
15 the PFBC/C in the presence of air and in the presence of  
calcium oxide;
  - (d) recovering a flue gas flow containing solids  
including calcium carbonate and calcium sulphate from  
the PFBC/C;
  - 20 (e) separating the solids from the flue gas  
flow;
  - (f) transferring the minor proportion of the fuel to a  
calciner;
  - (g) combusting the minor proportion of the flow of fuel  
25 in the calciner in the presence of both relatively pure  
oxygen and the solids flow separated in step (e) to  
convert the calcium carbonate in the solids flow into  
calcium oxide and carbon dioxide gas;
  - (h) recovering a flow of carbon dioxide gas from the  
30 calciner;
  - (i) recovering a flow of solids from the calciner  
including the calcium oxide generated in the calciner;

16. A process according to Claim 1 wherein the weight ratio of fuel in the major and minor proportions is about 2:1.

17. An apparatus for capturing and recovering carbon dioxide and sulphur dioxide from the combustion of a carbonaceous fuel having a high carbon content, a relatively high sulphur content and a low ash content, which apparatus includes in combination:

- 10 (i) a carbonaceous fuel feed line for a flow of carbonaceous fuel of a size suitable for use in a fluidised bed combustor;
- (ii) a splitter constructed and arranged to divide the flow of fuel in the fuel feed line into a major proportion and into a minor proportion;
- 15 (iii) a combustor fuel feed line constructed and arranged to receive the major proportion of the fuel flow from the splitter;
- (iv) a pressurised fluidised bed combustor and carbonator constructed and arranged to receive and  
20 combust the major proportion of the fuel flow from the combustor fuel feed line;
- (v) a compressed air line constructed and arranged to provide combustion air to the PFBC/C;
- (vi) a calcium oxide transfer line having a first end  
25 and a second end, the first end being constructed and arranged to feed a solids flow including calcium oxide to the PFBC/C;
- (vii) a separator feed line constructed and  
30 arranged to transfer a flow of flue gas containing entrained solids including calcium carbonate from the PFBC/C to a separator

combustion of a carbonaceous fuel with both a high carbon content and a relatively high sulphur content can each be recovered as a useable product. For example, carbon dioxide  
5 can be used in enhanced oil recovery processes and calcium sulphate can be used in the manufacture of building products such as gypsum wall board.

Thus in a first broad aspect, this invention seeks  
10 to provide a process for capturing and recovering carbon dioxide and sulphur dioxide from the combustion of a carbonaceous fuel having a high carbon content, and either a low ash content or a low ash content and a relatively high sulphur content, which process comprises:

- 15 (a) splitting a flow of carbonaceous fuel having a particle size compatible with combustion in a fluidized bed into a major proportion and a minor proportion;
- (b) transferring the major proportion of the fuel to  
20 a pressurised fluidised bed combustor and carbonator (PFBC/C);
- (c) combusting the major proportion of the fuel flow in the PFBC/C in the presence of air and in the presence of calcium oxide;
- 25 (d) recovering a flue gas flow containing solids including calcium carbonate and calcium sulphate from the PFBC/C;
- (e) separating the solids from the flue gas flow;
- (f) transferring the minor proportion of the fuel to  
30 a calciner;
- (g) combusting the minor proportion of the flow of fuel in the calciner in the presence of both relatively pure oxygen and the solids



Preferably, the carbonaceous fuel has an ash content of less than about 5%. More preferably, the carbonaceous fuel has an ash content of less than 1%.

5            Preferably the PFBC/C and the calciner are both operated at the same pressure. Alternatively, the PFBC/C is operated under pressure and the calciner is operated at ambient pressure.

10           Preferably, the PFBC/C and the calciner are both operated at a pressure of from about 15 bar to about 20 bar. Alternatively, the PFBC/C is operated at a pressure of from about 15 bar to about 20 bar and the calciner is operated at ambient pressure.

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In a second embodiment, this invention seeks to provide an apparatus for capturing and recovering carbon dioxide and sulphur dioxide from the combustion of a carbonaceous fuel having a high carbon content, a relatively high sulphur content and a low ash content, which apparatus includes in combination:

- 20            (i) a carbonaceous fuel feed line for a flow of carbonaceous fuel of a size suitable for use in a fluidised bed combustor;
- 25            (ii) a splitter constructed and arranged to divide the flow of fuel in the fuel feed line into a major proportion and into a minor proportion;
- (iii) a combustor fuel feed line constructed and arranged to receive the major proportion of the fuel flow from the splitter;
- 30            (iv) a pressurised fluidised bed combustor and carbonator (PFBC/C) constructed and arranged to receive and combust the major proportion of